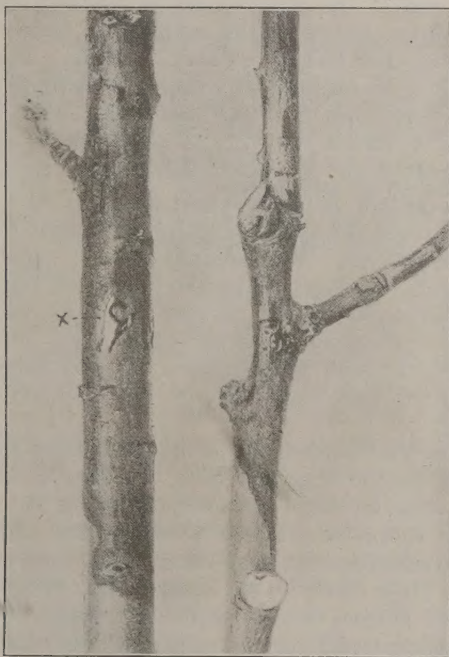


the grower is badly deceived as to just when the disease was acquired.

The following symptoms are very characteristic. If the infection begins in a flower cluster or in the end of a shoot, as it usually does, the leaves first wilt and droop, then turn brown in the apple and nearly black in the pear. Soon they become dry,



Blight canker on limbs of pear. Bacterial exudate at x.

hard, and brittle. The bark of the affected twig likewise becomes slightly darkened in the apple and nearly black in the pear. The line between the diseased and the healthy bark is not sharp and distinct during the growing season, so that it is often difficult to determine just how far the disease has progressed; and it is usually farther than an inexperienced person would suppose. On cutting into the diseased bark one finds the inside at first pinkish

in color instead of a healthy green, but when it has been diseased for a few weeks it becomes darkened through to the wood, which remains nearly white and normal. This is essentially a bark disease and will continue, in susceptible varieties, to run down the limbs and trunk into the roots, sometimes killing the tree outright in a single season. It practically ceases to spread downward at the end of the growing season and becomes dormant during the winter, but with the opening of spring activity is renewed and another stretch of bark is killed. This continues until the tree is completely overcome. Sometimes the attack begins in the water-sprouts at the base of the tree. Under these circumstances it reaches the roots in a few weeks, where it can not well be treated, and the case becomes practically hopeless.

There is a general impression that plants or animals that are very vigorous resist disease better than those that are generally unhealthy and stunted. This certainly is not the case with apple and pear blight. In slow-growing trees the disease makes but moderate progress downward through the bark and generally dies out without reaching the larger limbs, while in very rapidly growing, vigorous trees it progresses rapidly, sometimes running through the bark from the tips to the roots in a single season.

Often there may be seen on the blighted leaves and branches, and especially on the blighted fruits, a yellow exudate in tiny droplets, or even in larger quantities running down the tree. This contains enormous numbers of the germs of the disease and is freely visited and eaten by ants, wasps, bees, and probably other insects, that carry it to other trees, especially to the flowers, where a fresh attack begins. A single bee may thus infect several hundred flowers during the season, and a swarm of bees could infect many thousands. This accounts in most cases for the very extensive and sudden attacks that many orchards have suffered.

When the healthy leaves have fallen in the autumn, those on the diseased twigs and branches still cling to the tree, where they are very conspicuous. At this time also the diseased bark has turned quite dark, especially in the pear, and the line between it and the healthy bark is more sharp and distinct than during the summer season. Here, in the deeper layers of the bark, in

the line between the diseased and the sound tissues, the bacteria that cause the blight live over winter. On the assumption that they do not live over in the ground or anywhere else excepting the region just indicated, the following treatment is advocated by the United States Department of Agriculture and by many of the experiment stations, and is extensively practiced by orchardists with some measure of success.

TREATMENT OF THE BLIGHT

In a single sentence we can say that the only known method of curing a blighted tree is to cut out and burn all affected parts. This seems simple enough, but there are important details that determine between success and failure. As a matter of fact, very few inexperienced men are successful, largely because they will not pay close enough attention to these important details. The following rules should therefore be thoroughly mastered and rigorously followed.

1. See that no blight is allowed to winter over in the trees. The best time of the year to cut it out is late fall or early winter.

2. In the dormant season the blighted branch should be cut off about a foot below any visible portion of the disease; in the summer, two or three feet below. If this necessitates cutting off a larger limb, this should be done. It is this rule that is transgressed most often and with the most serious consequences.

3. After each cut the saw or shears must be disinfected: The disinfectant can best be carried in a milk bottle attached to the belt, and can be applied with a swab. Small corrosive sublimate tablets (four to a pint of water) make an excellent disinfectant. A 5 per cent solution of carbolic acid is also good.

4. Burn all diseased parts promptly after cutting. In summer this must be done the same day, otherwise insects crawling over them during the night may become carriers of the germs. In winter it is necessary to burn them before the first warm days of spring, but many have neglected this rule to their sorrow.

5. Inspect every tree carefully after the orchard has been gone over. Even an expert, when cutting out blight, has to do this two or three times to get every case, and a case or two left may ruin the whole campaign by starting the blight in the blossoms the next season.

6. Pruning. Orchards in infested districts should be kept free from water-sprouts at the foot of the trees, and from suckers and fruit spurs on the main limbs; otherwise the bacteria, entering through these tender parts, will quickly reach the roots or the trunk.



Left—Twig infection, probably through puncture by the green apple aphid.

Right—Tree doomed through water-sprout infection in the root.

7. Tillage and irrigation. Anything that favors a rapid, succulent growth of the tree makes it more susceptible to blight. It is, therefore, most important that blighted orchards should have no more tillage and water during the first half of the growing season than are absolutely necessary to the making of the

crop. Barnyard manure should be applied only to the more resistant varieties.

8. Kill the green apple aphid. Observation and experience have convinced us that the winged adult of this insect is the most important carrier of the blight after the bees stop working in the flowers. Thorough spraying with tobacco extract for the green aphid should greatly reduce the spread of blight during the summer.

The claim is sometimes made by those who have grown fruit in the East or the Middle West before coming to Montana that the cutting out of blight is not necessary, that such a practice was very little followed where they came from and yet apples were grown with very little trouble from blight. It is a fact, however, that nearly every apple district, East and West, has a severe outbreak now and then that requires severe cutting.

SELECTION OF RESISTANT VARIETIES

As already indicated, there is a great difference between varieties of apples and pears as to their susceptibility or resistance to this disease. Trees may be resistant in either of two respects or in both. First, if the blight germs get into the blossoms or the tender bark, a natural resistance of the tree may prevent them from getting a start in many cases. Second, if the disease gets a start in the blossoms, the leaves, or the tender shoots, it will in some susceptible varieties spread down into the bark of the larger branches, trunks, or even roots; while in other varieties more resistant, it will die out early in the season, forming only a "twig blight." This kind of resistance is the more important.

Nothing is so essential in fighting this disease as to avoid planting certain susceptible varieties, which are almost certain to be killed if attacked, and to pull out or top-work those already growing. It would be impossible and quite useless to list here all known varieties of apples and pears and state the degree of susceptibility of each, for most of them have no commercial value in the state. The Montana fruit growers, however, may find here listed most of those varieties that have a commercial value in one or more of our important sections, and they should be guided by it in the setting of new orchards.

Class A. Relatively resistant, i. e., the blight seldom runs far in limbs more than one-half inch in diameter, and usually makes only a twig blight.

Duchess of Oldenburg	Wagener
Gano	Stayman Winesap
Ben Davis	Thompkins King
Rome Beauty	

Class B. Moderately resistant, i. e., the disease seldom runs far in limbs more than three-fourths inch in diameter, and usually makes only a twig blight.

McIntosh Red	Wealthy
Jonathan	Baldwin
Delaware Red	Northwest Greening
Grimes Golden	

Class C. Moderately susceptible, i. e., the disease frequently penetrates the smaller limbs (an inch or less in diameter) but seldom the main limbs or the trunk.

Yellow Transparent	Whitney crab
Fameuse (Snow)	Martha crab
Spitzenburg	Hyslop crab
Delicious	

Class D. Very susceptible, i. e., many infections may appear in a tree; the blight extends rapidly into the larger limbs and trunks, and the tree is usually killed.

Alexander	McMahon
Wolf River	Winter Banana
Transcendent crab	

In considering the foregoing lists the grower should understand that classes A, B, and C rank quite close together and that any of those varieties can probably be grown successfully even in blight-infested districts of the state; while between class C and class D there is a very wide difference, the latter being very much more susceptible. It is an exceedingly important fact that in trees belonging to classes A and B the blight germs nearly always die out in the bark before winter and almost never live over until the next spring, while in those belonging to class C they frequently live over winter, and in those of class D they quite regularly do so and thus start a new infection in the orchards at blossoming time. Our orchardists should not attempt

longer to grow these five varieties. When the state was free from blight some of them proved very profitable, but now they are doomed to be replaced by others that are more resistant. It would be most unwise, therefore, for a grower to set them out.

As for the trees of susceptible varieties that have already been planted and have reached the age of bearing, they may be top-worked to varieties more resistant. This applies especially to the Alexander, which is in most respects an excellent stock upon which to graft other varieties. Trees thus treated, if kept free from water-sprouts, will make valuable orchards and will thrive even in the midst of blight, only occasional trees being lost. If, however, the water-sprouts are allowed to grow, they furnish the blight with a quick and easy path to the root of the tree, and the orchard may thus be ruined.

RELATIVE RESISTANCE OF THE PEAR

Pears have been grown only to a limited extent in Montana, but those trees that have come into bearing have proved so profitable that something should be said for the guidance of those who may be thinking of planting them more extensively.

It is a misconception that pear trees growing in any locality are a special menace to the apple industry. Pears are no more likely to contract blight than apples; and if they have it and the owner desires to fight it he will find it not so difficult to combat in the pear as in the susceptible apples.

The reason for this is that the normal bark of the pear is lighter in color and the blighted portions darker than in the apple; it is therefore easier to find all the blighted limbs. In general, we may say that it is much easier to control the blight in pears than in apples listed in class D.

Pears, like apples, differ in their susceptibility to this disease. The Clapp's Favorite, for example, blights so badly that it can not be grown commercially with profit. The Kieffer, on the other hand, is about as resistant as the apples in class B. Unfortunately, it is not a first-class variety for eating, though it is prized by the canneries. There are three other varieties that have commercial possibilities in this state, the Bartlett, Buerre d'Anjou, and Flemish Beauty. Of these the Bartlett is the most susceptible, though hundreds of thousands of trees are being

grown where blight has existed for years. Buerre d'Anjou is decidedly the most resistant, being raised very profitably in Colorado, for example, where the blight has greatly injured most other varieties. Both of these are decidedly superior in quality of fruit to the Flemish Beauty.

All pear orchards grown where blight is found will develop some cases in the tops—many of them if the orchards are neglected. These may be controlled, however, by the methods outlined in this circular. The principal loss of trees is caused by the blight's running down the limbs into the trunks, or, worse yet, by its reaching the roots through the water-sprouts. To avoid this loss it is important that a pear tree shall have a body and roots of a variety resistant to blight and not likely to sprout. Use for a stock the Chinese sand pear, often called "Japanese" stock, which is much more resistant than the French seedling and does not sucker so badly. Upon this graft the Kieffer or some equally resistant cion. Set deep in the ground so that the roots will be sent out above the union. In pruning leave four main limbs, and the second or third year after grafting top-work these limbs to the desired variety—for example, Buerre d'Anjou. The buds or grafts should be set one to two feet from the trunk. This will make a fine, large tree; and should the blight run down a limb to the point of union it will there be checked, and a new limb can be grown in the place of the one lost. For convenience one may order from the nursery Kieffer stock on "Japanese" roots and do the top-working himself at the proper time. This system has been thoroughly tried and we recommend it unqualifiedly to those who wish to grow this much-prized fruit.

This department of the Experiment Station has devoted considerable time and funds to the task of presenting to the orchard interests of the state the best methods for the control of this disease. The execution of the work and the enforcement of the laws must remain with the growers themselves and the horticultural division of the State Department of Agriculture. Should improved methods of control be devised by the Experiment Station, they will be made available; for it is realized that those now in use throughout the country are far from perfect and will at best only partially control this disease.

